JOINT VENTURE (HSV-X1)

TRANSPORTABILITY ANALYSIS OF VESSEL LOADING DURING MILLENNIUM CHALLENGE 2002

Port Hueneme, California, to Port of Tacoma, Washington

(11 Thru 13 August 2002)

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1. High Speed Vessel-Experimental 1 (HSV-X1), Joint Venture, Participation in Millennium Challenge 2002

Millennium Challenge 2002 (MC02) was a joint integrating event that brought together both live field exercises and computer simulations. The U.S. Joint Forces Command sponsored the Congressionally mandated exercise. MC02 simulated a high-end, small-scale contingency that had the potential to escalate to a major theater war. It incorporated elements of all military services, most functional/regional commands and many Department of Defense (DOD) organizations and federal agencies. Elements of future force concepts from the Air Force's Expeditionary Aerospace Force, the Army's medium-weight brigades, and the Navy's "Forward From the Sea" were involved.

During MC02, the HSV-X1, Joint Venture, was a highlight of the exercise. It was used to demonstrate the potential impact that fast, shallow draft, open architecture vessels with large payloads can have on mine warfare, special operations, ship-to-objective maneuver and medical and noncombatant support operations. During the exercise, the HSV-X1 was used to transport elements of a Stryker Brigade Combat Team (shown in table 2) from Port Hueneme, CA, to Tacoma, WA. This was the Army's first demonstration of the vessel's ability to transport complete packages of combat-ready soldiers with their equipment.

2. HSV-X1 Charter, Modifications and Specifications

The HSV-X1 is chartered under a 2-year contract between a consortium of U.S. military services and Bollinger/Incat USA. The consortium is led by the U.S. Army's Tank-Automotive and Armament Command (TACOM), and includes the U.S. Navy, Coast Guard, Marine Corps, and Special Operations Command.

Technical and structural modifications were made on the vessel to meet military requirements. They included the installation of a large helicopter deck; a two-part hydraulically operated stern quarter ramp, troop facilities, crew accommodations, and a deployment gantry for rigid inflatable boats. In addition, a portable exterior ramp was constructed and is stowed on the helicopter deck. This ramp allows for onload/offload of the vessel straight from the stern.

Specifications for the HSV-X1 are:

- Length Overall: 313'3"
- Beam: 87'4"
- Personnel Capacity: 360 (troops and crew)
- Max Draft (Full Load): 13'0" (4 meters)
- Displacement Tonnage (Full Load): 1,740 tonnes (1,918 STON)
- Deadweight: 741 tonnes (815 STON)
- Cargo Deadweight: There is no set cargo carrying capacity for this vessel as it is dependent on the weights of the amount of fuel, passengers, baggage, crew, and water that will be carried for each voyage. See table 1 for cargo deadweight (payload) capacities and associated ranges.

TABLE 1: HSV-X1 PAYLOAD VERSUS RANGE							
Items of Vessel Deadweight Excluding Cargo					Total Vessel Dead-Weight (STON)	Total Cargo Payload[3] (STON)	Distance in Nautical Miles
Crew/Effects, Fresh Water, Misc Stores/ Provisions (STON)	No.Pax/ Weight (STON)[1]	No. Drivers/Weight (STON)[2]	Fuel w/25% Reserve (STON)	Lube Oil (STON)			
20.2	0/0	13/2.1	162	1	185.5	629.5	800
20.2	325/47	13/2.1	162	1	232.5	582.5	800
20.2	0/0	13/2.1	258.6	1	281	534	1250
20.2	325/47	13/2.1	258.6	1	328	487	1250
20.2	0/0	13/2.1	375	1	398.3	416.7	2400
20.2	325/47	13/2.1	375	1	445.3	369.7	2400
[1]Pax Wt = .15 STON each [2]Driver Wt = .15 STON each [3]815 STON Minus Items of Vessel Deadweight							

- Speed: Loaded – 38 knots; Light – 48 knots max
- Range: 2,400 nautical miles with 25% fuel reserve
- Cargo Area: The militarily useful cargo area of the HSV-X1 is 12,114 square feet (taken from ICODES) or, if the new portable ramp is stowed on the main deck of the vessel, this cargo area decreases by 562 square feet to 11,552 square feet. Figure 1 shows all of the deck areas for this vessel. Only the main deck and area under the hoistable mezzanine vehicle deck can be used to load military vehicles. The ramp areas could be used for palletized equipment or other small items.
- Engines: 4 resiliently mounted Caterpillar 3618 marine diesel engines rated at 7200 kW at 100% MCR.
- Water Jets: 4 Lips 150D waterjets configured for steering and reverse
- Ride Control: A "Maritime Dynamics" active ride control system is fitted to maximize passenger comfort. The system combines active trim tabs aft and bolt-on T-foils at the forward end of each hull.

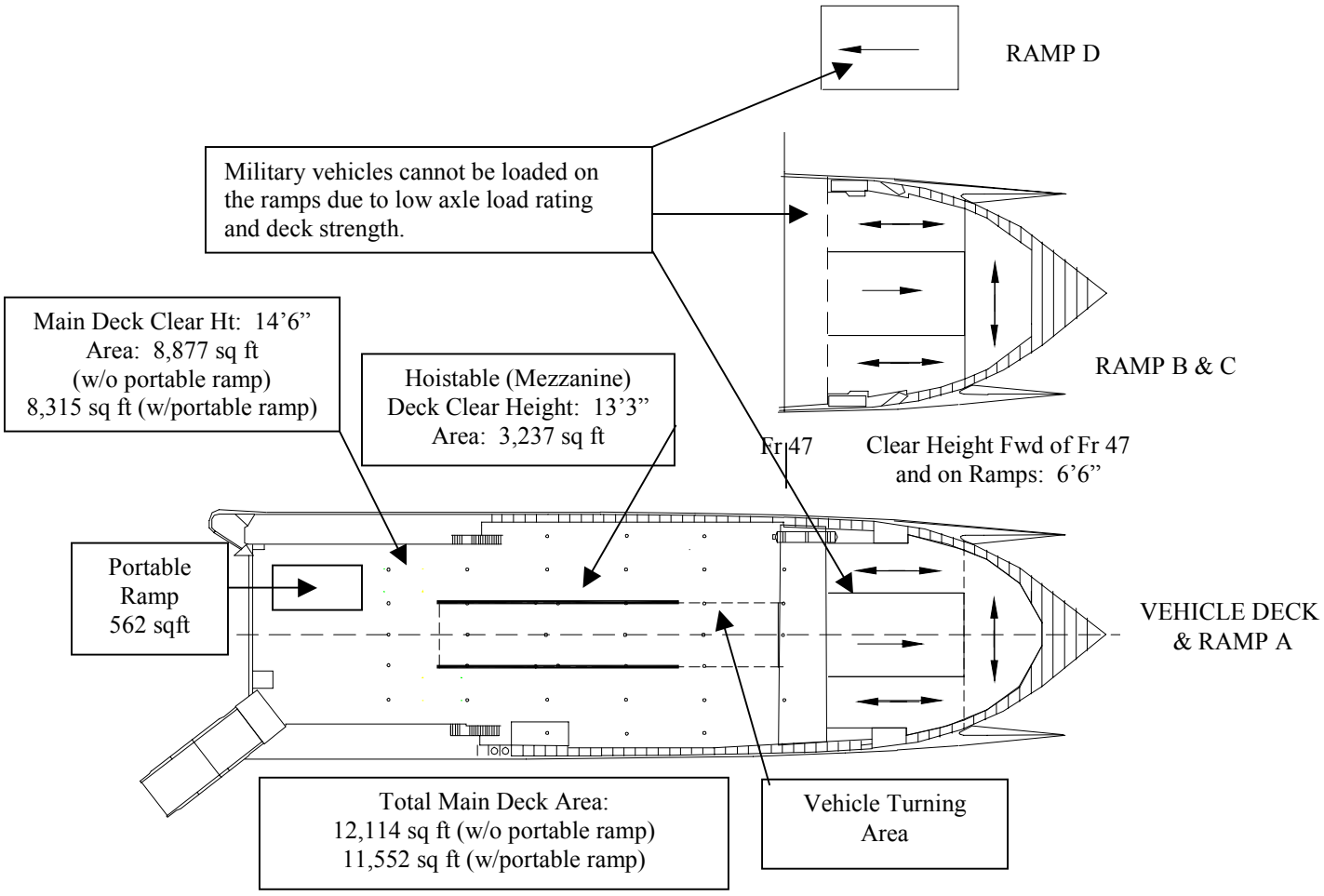

Figure 1. Deck Layout of HSV-X1

3. Vessel Loading

a. Port of Embarkation. On 11 August 2002, 28 vehicles, including 14 Strykers, were loaded on the HSV-X1 at Port Hueneme, CA. Table 2 shows the equipment load list and the ship's gear that was on the vessel for this exercise.

Table 2. MC02 Equipment List									
Model Number	**Description**	**Qty**	**Length (in)**	**Width (in)**	**Height (in)**	**Area (SqFt)**	**Total Area (SqFt)**	**Weight (STON)**	**Total Weight (STON)**
Stryker	Inf Carrier Veh	14	284	110	109	217	3038	19	266
M1083	Trk Cgo, MTV	2	278	96	112	185	370	11.24	22.48
M149A2	Trailer Tank Water	2	162	81	81	91	182	1.5	3
M984A1	Truck Wrecker	1	402	102	102	285	285	25.2	25.2
M998A1	Trk Util Cgo	4	181	84	74	106	424	2.6	10.4
M966	Trk Utill 1 ¼ T	3	180	100	74	125	375	3.6	10.8
M1101	Tlr Cgo HIMOB ¾ Ton	1	136	86	100	81	81	0.7	0.7
M1102	Tlr Cgo HIMOB 1 ¼ Ton	1	136	86	100	81	81	0.7	0.7
	Total Equipment	**28**					**4836**		**339.28**
				Ship's Gear Onboard Vessel					
MILVAN	Caterpiller Container	1	240	96	96	160	160	4	4
MILVAN	Incat	1	240	96	96	160	160	5	5
Ramp	Stern Ramp	1	473	187	50	614	614	7.4	7.4
ISU-90	W/Locker	1	108	88	75	66	66	2.4	2.4
ISU-90	A-Locker	1	108	88	75	66	66	2.4	2.4
Gear	Oil Drums Misc Items	1	300	250	50	521	521	10	10
Spt Van	Incat Spt Van	1	201	73	68	102	102	3	3
Hertz	Forklift Lease	1	194	85	97	108	108	7.14	7.14
Gator	GUV	1	111	61	44	47	47	0.7	0.7
60 Hz	Gen Set	2	90	45	54	28	56	2.2	4.4
Boat	RHIB	1	204	84	36	119	119	0.8	0.8
	Total Ship's Gear	**12**					**2019**		**47.24**
Total Cargo		**40**					**6855**		**386.52**

b. Stowplan. Figure 2 shows the stow locations of this equipment to include some of the larger pieces of ship's gear. Smaller items of ship's gear were stowed on the ramps.

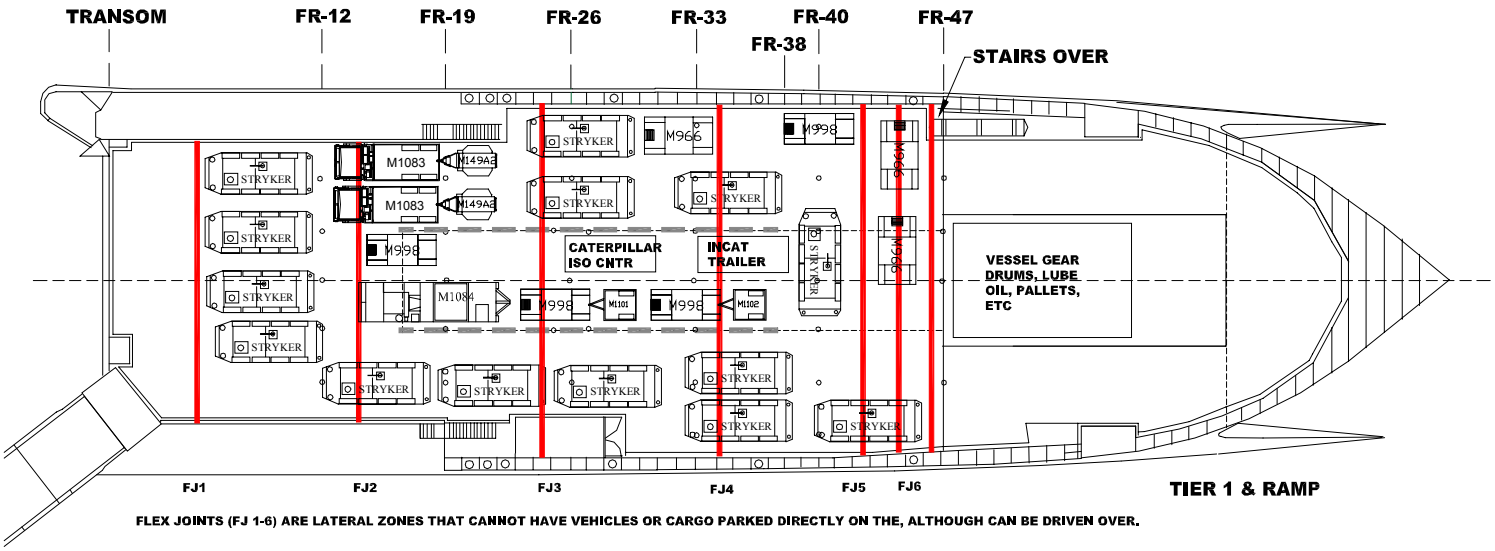

Figure 2. Stowplan of the HSV-X1 for MC02

c. Onload. Equipment was staged according to the priority of load onto the vessel. Loading started at 1210 hours PDT on 11 August 2002, with military personnel driving the vehicles onboard the vessel in the following sequence:

(1) The M1084 wrecker was driven up the side ramp and maneuvered in the open area in the aft section and backed into its stow position at the center area under the hoistable deck on the starboard side.

(2) Two M998s with trailers traveled from the ramp on the starboard side and turned in the forward section (Fr 40 - 47) to their stow location behind the M1084 wrecker. These vehicles could not make the turn into the stow area; they had to back-up before they could be positioned properly.

(3) Two Strykers went up the stern ramp and traveled on the starboard side and turned to maneuver into their stow location between the Transom and Fr 12 on the port side aft. These vehicles maneuvered into this area with no difficulty.

(4) Two M1083s with M149A2 trailers moved up the stern ramp and traveled on the starboard side and turned in the forward area and parked on the port side behind the Strykers at Fr 12 (port). One of the vehicles had to back up to maneuver into its stow area. The other waited and then moved into place. These two vehicles were stowed side by side with approximately 1-foot of space between them.

(5) Two M966s and one Stryker were stowed athwartship in the forward section between Fr 40 and 47.

(6) All of the other vehicles maneuvered into their stow locations without any difficulty.

d. Onload Time. Loading stopped at approximately 1250 hours for a total onload time of 40 minutes.

e. Lashing. Once the vehicles were loaded, military stevedores started lashing operations. Vehicles were lashed to existing deck tiedowns and the newly added Peck and Hale (P&H) cloverleafs (fig 3) that are rated @ 6.5 tons each and spaced 27.5 feet longitudinally and 10' laterally apart. Lashing gear consisted of 1-ton and 2.5-ton cargo straps, 1.75-ton and 4.25-ton P&H chain gripes. The vehicles were lashed to only a few of the newly added P&H cloverleafs. Most of the vehicles were lashed to the original vessel tiedown tubes (figs 4 and 5) that are rated for .8 tonne (1,764 lbs) axle load cars only.

Figure 3. Peck and Hale Cloverleaf (New)

Figure 4. Original Vessel Tiedown Tube .8 Tonne Axle Rating

Figure 5. Strykers Lashed to Vessel Tiedown Tubes

f. Total Load/Lash Time. Cargo lashing was complete at 1400 hours. Total time for loading and lashing cargo was 1 hour 50 minutes.

4. Vessel Departure and Transit

a. The HSV-X1 departed Port Hueneme, CA, at approximately 1430 hours PDT on 11 August 2002. Passengers included members of the 3rd Bde, 2ID Infantry Company and the battalion staff, ATEC data collectors, Boeing, CASCOM, media representatives, AMC materiel developers, Incat/Bollinger representatives, 7th Trans Group, TACOM and MTMCTEA. Destination for offload was the Port of Tacoma, WA.

b. During the transit, rough seas with approximately 9- to 12-foot waves (Sea State 5) were encountered. When MTMCTEA engineer, John Atwood, entered the cargo area to observe the effect of the high seas on the equipment, he noticed that the Strykers started to bounce and move back towards the aft end of the vessel. The impact of the vessel slamming caused the suspension systems of the Strykers to bottom out causing these vehicles to move in a violent vertical motion. This movement caused the lashing gear to become very loose on the downward motion of the vehicle and during this time they slid on the wet deck. Some of these vehicles moved approximately 1' from their original stow location. The military stevedores and other ship personnel added straps to the Stryker's tires (see fig 6) to reduce the movement and prevent damage to the other equipment and the vessel.

Figure 6. Straps Added to Stryker Tires

c. The vessel slamming also caused some of the other equipment such as the HMMWVs to move vertically. The vertical movement of this equipment was due to the types of lashing restraints and the tiedown procedures that were used. Tiedowns should reduce the normal height of a vehicle between 1 and 3 inches. This reduction did not take place during this exercise because of the inadequate lashing gear and vessel tiedown strength.

d. The waves were steep enough to cause "double slamming." Vessel speeds varied in an attempt to reduce the slamming. During this time, a great deal of salt water sprayed through the aft open area of the cargo deck. The vessel deck, gear, Strykers and other equipment in this area got very wet. The deck became very slippery and added to the movement of the cargo during the high seas.

5. Vessel Arrival and Offload

a. The HSV-X1 arrived at Pier 7, Port of Tacoma, at 0807 hours PDT on 13 August 2002. Total transit time from Port Hueneme to Tacoma was 41.5 hours. According to the Fairplay Veson Distance Tables, the distance from Port Hueneme, CA, to Tacoma, WA, is approximately 1,200 nautical miles. At 1,200 nautical miles and 41.5 hours transit time, the average speed computes to be 29 knots per hour. Vessel speed had to be reduced to 15 knots when it entered the Straight of Seattle (approximately 6 hours) due to Coast Guard requirements.

b. While the HSV-X1 was in the harbor, military stevedores unlashed the equipment so that it could be offloaded as soon as the vessel arrived at the pier. Offloading the 28 pieces took only 13 minutes. This time does not include the HMMWV that was deadlined due to a battery problem.

6. Observations

a. Cargo Area

Ship's gear (i.e., 2 containers, 1 forklift, spanners, guard shack, and support van) takes up valuable cargo stowage area. During this exercise the portable ramp was stowed on the helicopter deck but it is sometimes stowed in the aft end of the vessel for self-sustaining operations. When the ramp is stowed on the helicopter deck, a shoreside crane is required to move it. When it is stowed in the aft end, the overhead crane can move it so that it can be used to load cargo from the stern. The ship's gear should be located in areas that will not interfere with the loading and actual stowage of military equipment.

Deck heights and axle load ratings on the interior ramps restrict the type of cargo that can be stowed in these areas. These areas should at least accommodate a fully loaded HMMWV and trailer combination.

The hoistable deck on this vessel has no military utility. If the hoistable deck and its supporting structure are removed, then the center area would be clear of obstructions and vehicle maneuvering and loading would be easier.

b. Ramp. During the onload, the tidal conditions were at a point where the quarter stern ramp was positioned evenly with the apron and the vessel entrance (fig 7). If the tide were lower, then the ramp would have hit the apron and the ramp would have to be adjusted to avoid contact with the apron. The ramp at low tide is shown in figure 8. This configuration requires the use of wooden inserts in the forward ramp joint to load vehicles. The quarter stern ramp should be redesigned to automatically adjust to aprons of various heights and tidal conditions without using wooden inserts.

Figure 7. Ramp at High Tide

Figure 8. Ramp at Low Tide

c. Maneuvering. The M1084 wrecker had to maneuver in the open area to back into the center area under the hoistable deck. Two M998s with trailers also had to back-up to get to their stow location. The Strykers and other vehicles were able to maneuver through the vessel with no problems. If the center area of the vessel could be free of obstructions like the hoistable deck structure, then maneuvering large vehicles and truck trailer combinations would be much easier.

d. Deck Fittings

Approximately 39 P&H raised cloverleafs were added to the deck of this vessel to accommodate tiedown of large vehicles. Vehicles were lashed to the existing vessel tiedown tubes and most of the P&H cloverleafs were not used during this exercise. The P&H cloverleafs are situated on the deck so that the Strykers could have been positioned between them.

These cloverleafs should be flush with the deck and the tube tiedowns should be replaced with stronger fittings to avoid damage to the vehicles and the vessel. Fittings should be placed on a 4'x 4' grid throughout the cargo area.

e. Lashing Gear

The lashing restraints were not sufficient in strength for this type of load. During the ocean transit to Port of Tacoma, rough seas caused the HSV-X1 to slam violently inducing vertical cargo movements. A minimum requirement for the Stryker should be eight 35K P&H restraints with rubber snubbers to absorb the shock load.

These vessels should be instrumented to determine the type of G forces that will be encountered by the vehicles being transported at various sea states. This will assist in determining the appropriate strength requirement for cargo restraints and deck fittings. Pending collection of this data, recommend lashings have the capacity to restrain the cargo to a minimum of 1G.

7. For additional information on the HSV-X1, please consult MTMCTEA "Loadplanning and Transportability Analysis" dated 16 September 2002. POCs for this action are Mrs. Terry DeLucia, (757) 599-1669, terry.delucia@tea.army.mil or Mr. John Atwood, (757) 599-1648, john.atwood@tea.army.mil.